

# PATENT SPECIFICATION

(11)

1 345 408

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- (21) Application No. 29297/71 (22) Filed 22 June 1971 (19)  
 (31) Convention Application No. 62297 (32) Filed 24 June 1970 in  
 (33) Japan (IA)  
 (44) Complete Specification published 30 Jan. 1974  
 (51) International Classification H01J 7/18  
 (52) Index at acceptance  
 H1D 12G 35 5A 5Q 9A 9CX 9CY 9Y  
 H2H 2B7



## (54) FLASH DISCHARGE LAMP FOR PHOTOGRAPHIC USE

- (71) I, SHING CHEUNG CHOW, a citizen of Hong Kong, of 12A Suffolk Road, Kowloon, Hong Kong, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—  
 This invention relates to a flash discharge lamp for photographic use having stable operating characteristics over a long period of time, and yet which is small, and  
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### ERRATA

SPECIFICATION NO 1345408

- Page 1, line 48, *for* helim, *read* helium,  
 Page 1, line 49, *for* dryton, *read* crypton,  
 Page 2, line 118, *after* 14 *insert* of  
 Page 3, line 40, *after* conducted *delete* or emitted

THE PATENT OFFICE  
 8 April 1974

R 74645/17

- blackening of the bulb makes it difficult to use a photographic apparatus or a stroboscope properly.  
 35 In order to avoid these drawbacks, it is known to make the bulb relatively large. For the general use of the flash discharge lamp, for example, for a photographic apparatus or a stroboscope, however, a rather  
 40 small lamp is preferable.  
 For example, a flash discharge lamp of the prior art as used in a photographic apparatus is relatively small, of which the glass bulb is 4 mm in diameter and 40 mm  
 45 in length in which an anode and a cathode, each in the form of a thin rod, are disposed opposite to each other, and which is filled with an inert gas such as helim, neon, argon, dryton, or xenon. After a condenser con-  
 50 nected to both electrodes of the lamp has been charged with energy to a predetermined extent, the energy is momentarily discharged from the condenser and applied to a starting electrode of the lamp through  
 55 a voltage raising transformer in the form of pulsative raised voltage. Though the discharge lasts only for a very short period of time, the lamp requires so large an amount of energy to flash that a large quantity of gases and other impurities is gener-  
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[Price 25p]

SEE ERRATA SLIP ATTACHED

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## (54) FLASH DISCHARGE LAMP FOR PHOTOGRAPHIC USE

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This invention relates to a flash discharge lamp for photographic use having stable operating characteristics over a long period of time, and yet which is small, and simple in construction and easy to manufacture.

The flash discharge lamp constructed according to the invention is especially useful for a photographic apparatus, a stroboscope and the like as it maintains stable luminous performance for frequent use over a long period of time.

A flash discharge lamp known in the prior art involves drawbacks that after frequent use, it fails to start unless a voltage higher than its design voltage is applied, and that the bulb of the lamp blackens due to gases and other impurities resulting from electric discharge, which brings about a lowering in its luminous performance and can be a cause of cracking of the bulb. Especially when the flash discharge lamp is used to obtain a flash light, the above mentioned lowering in luminous performance caused by the blackening of the bulb makes it difficult to use a photographic apparatus or a stroboscope properly.

In order to avoid these drawbacks, it is known to make the bulb relatively large. For the general use of the flash discharge lamp, for example, for a photographic apparatus or a stroboscope, however, a rather small lamp is preferable.

For example, a flash discharge lamp of the prior art as used in a photographic apparatus is relatively small, of which the glass bulb is 4 mm in diameter and 40 mm in length in which an anode and a cathode, each in the form of a thin rod, are disposed opposite to each other, and which is filled with an inert gas such as helium, neon, argon, dryton, or xenon. After a condenser con-

nected to both electrodes of the lamp has been charged with energy to a predetermined extent, the energy is momentarily discharged from the condenser and applied to a starting electrode of the lamp through a voltage raising transformer in the form of pulsative raised voltage. Though the discharge lasts only for a very short period of time, the lamp requires so large an amount of energy to flash that a large quantity of gases and other impurities is generated as compared with the capacity of the lamp whereby the proper function of the lamp is often degraded.

A getter is, therefore, used to absorb such undesirable products of discharge, and barium has usually been used as a getter for a flash discharge lamp according to the prior art. But barium vaporizes when heated, and adheres to and dims the wall of the lamp. The dimmed portion of the wall has a large capacity for absorbing heat and is heated up to a very high temperature as compared with the remaining portion of the wall, so that the lamp is liable to crack. The dimmed wall also lowers the luminous performance of the lamp. Furthermore, after frequent use, the lamp requires a higher voltage to start discharge than the design voltage, and as a consequence, the effective life of the bulb is substantially shortened.

It is known that solid metals such as titanium, tantalum and zirconium absorb a large volume of certain gases when they are heated to a certain temperature. If any of these metals is used as a getter however, it has been necessary to heat it to such temperature by supplying an electric current or otherwise. This complicates the construction of a discharge lamp to such an extent that it is very difficult, if not impossible, to use such solid getter for a relatively small discharge lamp available in the prior art.

According to the present invention there is provided a flash discharge lamp for photographic use comprising a pair of electrodes said lamp being filled with an inert gas, wherein a getter of solid material is welded

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to at least one electrode on or near its free end, whereby the getter is adapted to be heated by the collision of electrons or ions and by the heat conducted from the electrode when the flash discharge lamp flashes.

A preferred embodiment of the discharge lamp according to this invention will now be described with reference to the accompanying drawings, in which:—

Fig. 1 is a side elevation in section of a preferred embodiment of the flash discharge lamp according to this invention;

Fig. 2 is an enlarged side view showing one end of the cathode and a getter mounted thereon according to another embodiment of the invention; and

Fig. 3 shows a preferred example of an electric circuit for operating the flash discharge lamp according to this invention.

Referring now to Fig. 1, the numeral 1 denotes a glass bulb measuring, for example, 3.6 mm in outer diameter by 40 mm in length. An anode 2 and a cathode 3 are each made of a thin tungsten rod, and are incorporated into the bulb 1 in a sealed manner. The bulb 1 is filled with an inert gas such as helium, neon, argon, krypton or xenon under optimum pressure. A small piece of titanium 5 is fixed by spot welding or otherwise directly to or near one end 4 of the cathode 3. The titanium piece 5 may preferably be disposed in such a manner that it projects to some extent from the end 4 of the cathode 3 toward the anode 2 as shown in Fig. 1. The cathode 3 is covered all over its surface with a thin film of barium oxide to ensure a better emission of electrons.

The anode and the cathode may be incorporated and the inert gas introduced into the bulb by any known method, but the film of barium oxide is preferably provided in the manner as hereinafter described. After the titanium piece 5 is welded to the end of the tungsten cathode rod 3, the rod 3 is coated with barium nitride  $Ba(N_3)_2$  and is then incorporated into the bulb 1. The bulb 1 is then heated from outside by high frequency heating means, and nitrogen gas is exhausted through an outlet (not shown). The barium remaining in the bulb combines with the residual oxygen to form a thin film of barium oxide around the cathode rod 3. Then, any inert gas is introduced into the bulb, and the bulb closely sealed, by known methods. The numeral 7 indicates a starting electrode, and the outer surface of the glass bulb is covered with a transparent conductive film, e.g., a thin tin oxide NESA (Registered Trade Mark) coating, to ensure easier passage of an electric current through the wall of the bulb.

It will be obvious that while it is not always necessary to dispose the titanium piece 5 projectingly from the end 4 of the

cathode, the piece 5 may be flush with the free end of the electrode or be spaced slightly apart from the end 4, say about 3 mm. What is important in this connection is to dispose a getter of solid material, e.g., titanium in a position where the getter can have heat conducted thereto from the end of the cathode most effectively and, at the same time, the electrons or ions produced by discharge collide against the getter most effectively. The getter may preferably be in the form of a U-shaped ribbon 5' and mounted on the end 4 of the cathode 3 as shown in Fig. 2. It will, however, be observed that the getter may be of any other suitable shape, and be disposed in any other position on the cathode, depending on the type, application and characteristics required of a particular discharge lamp, without departing from the scope of this invention.

In operation, electrons move from the cathode 3 to the anode 2 and ionize part of the neutral inert gas before it reaches the anode. Positive ions separated from electrons collide against the titanium piece 5 and the cathode 3, so that the piece 5 is heated by the ions colliding thereagainst. The piece 5 is also heated by thermal conduction from the end of the cathode 3 at which point the cathode is raised to a higher temperature than at any other portion thereof. Thus, it will be noted that the piece 5 may easily be heated to an optimum temperature for adsorbing gases produced by electric discharge even when the discharge only lasts for an instant. Therefore, all harmful gases produced by discharge are adsorbed by the titanium piece or getter 5, and the flash discharge lamp is always kept in its proper condition to effect electric discharge as required.

Reference will now be made to Fig. 3 showing an electric circuit for operation of a preferred embodiment of this invention. The anode 2 and the cathode 3 are connected to a direct current power source. A condenser 9 is directly connected to these two electrodes, and a condenser 10 is connected to them via a resistance 11. A primary coil 12 of a transformer for raising voltage is provided to connect the terminals of the condenser 10 via a switch 13, and a secondary coil 14 the transformer is connected to the starting electrode 7 at one end thereof and is earthed at the other end. It has been found from experiments that when various electric components have, for example, constants as shown in Fig. 3, the switch 13 may successfully be actuated to produce a flash discharge in the bulb 1. From these experiments, in which five discharge lamps filled with xenon were used, it was found that all the lamps required a starting voltage of approximately 185V in the beginning. Five thousand flash discharge tests were conducted with each of

those five lamps by using the electric circuit as shown in Fig. 3, and a slight drop in the starting voltage down to approximately 180V was observed on each of the lamps upon completion of the tests.

Reference has been made in the foregoing description of a preferred embodiment of this invention to a flash discharge lamp wherein a titanium piece or getter 5 is disposed on or near the end 4 of a cathode 3. It will, however, be noted that the getter 5 may alternatively be mounted on or near the corresponding end of an anode 2. In this case, the heat required to raise the temperature of the getter is provided by the collision of electrons or negative ions against the getter and by thermal conduction reaching there from the end of the anode. It will also be observed that a getter may be mounted on each of the anode and the cathode. Moreover, it will be understood that the rod shaped electrodes described in connection with a preferred embodiment of this invention may instead be in the form of a ball, a disc or any other shape depending on the type, application and characteristics required of a particular flash discharge lamp. Likewise, such materials as zirconium and tantalum may be used to prepare a getter.

The following is a summary of the advantages of the discharge tube according to this invention:

1. As a getter of solid material is mounted on or near one end of at least one of the electrodes, the getter is very easily heated up to an optimum temperature for the most effective activation thereof by the heat generated by the collision of electrically charged particles against the getter and by the heat conducted or emitted thereto from said end of the electrode. Thus, the getter does not require any special means for heating it. Moreover, the getter can be attached to or near the electrode very easily, and only requires a very small space for its incorporation in the bulb. Therefore, the flash discharge lamp according to this invention can be reduced in size to such an extent as has not been possible with a flash discharge lamp in the prior art in which a solid getter is used.

2. The use of a getter of solid material such as titanium, tantalum and zirconium serves to prevent any possibility of an undesirably dimmed or blackened tube wall and an abnormally high temperature gradient resulting therefrom which may lead to the cracking of the tube. This helps successfully reduce the diameter of the bulb to a remarkable extent.

3. The getter becomes active upon occurrence of each discharge in case of flash discharge. Accordingly, the flash discharge lamp according to this invention keeps itself

in a position to effect a proper discharge at any time.

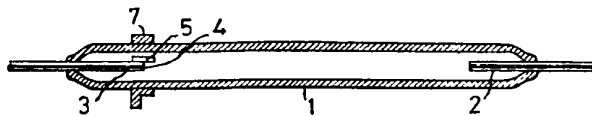
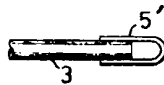
4. The flash discharge lamp according to this invention has a very long life because it hardly undergoes an undesirable change in the starting voltage even after repeated use over a long period of time. Prior art flash discharge lamps of the kind herein discussed have often failed after repeated use because of an undesirable increase of the starting voltage and lowering of their luminous performance. Because of its features and advantages hereinabove described, however, the flash discharge lamp according to this invention has been found to have a life approximately ten times as long as that of any flash discharge lamp available in the prior art.

5. Advantageously the flash discharge lamp of this invention can stand very high power and under such high power condition, the getter maintains its function properly because a solid piece of zirconium, titanium or tantalum is used as getter material. Zirconium, titanium or tantalum has very great heat resistance and will not be destroyed readily under great heat, unlike other getter materials, such as barium and aluminium.

#### WHAT I CLAIM IS:—

1. A flash discharge lamp for photographic use comprising a pair of electrodes, said lamp being filled with an inert gas, wherein a getter of solid material is welded to at least one electrode on or near its free end whereby the getter is adapted to be heated by the collision of electrons or ions and by the heat conducted from the electrode when the flash discharge lamp flashes.
2. A flash discharge lamp as claimed in Claim 1, wherein the getter projects from said end of the electrode.
3. A flash discharge lamp as claimed in Claim 1, wherein said getter is welded in such a manner that one end of said getter is flush with said free end of said electrode.
4. A flash discharge lamp as claimed in Claim 1, wherein said getter is a solid piece of titanium.
5. A flash discharge lamp as claimed in Claim 1, wherein said getter is a solid piece of zirconium.
6. A flash discharge lamp as claimed in Claim 1, wherein said getter is a solid piece of tantalum.
7. A flash discharge lamp substantially as herein described with reference to the accompanying drawings.

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**FIG-1****FIG-2****FIG-3**